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**FILED**

**JUL 08 2016**

**SECRETARY, BOARD OF  
OIL, GAS & MINING**

**BEFORE THE BOARD OF OIL, GAS, AND MINING  
STATE OF UTAH**

**IN THE MATTER OF THE PETITION  
OF GENWAL RESOURCES, INC., FOR  
REVIEW OF DIVISION ORDER 10-A**

**SUBMISSION OF UPDATED  
HYDROLOGIC REPORT  
DATED JULY 7, 2016**

Docket No. 2010-026

Cause No. C/015/0032

Genwal Resources, Inc. by and through its counsel of record hereby submits the Crandall Canyon Mine Hydrologic Update Report dated July 7, 2016, prepared by Petersen Hydrologic, attached as Exhibit A.

RESPECTFULLY SUBMITTED this 8th day of July, 2016.

BY: \_\_\_\_\_

  
ATTORNEYS FOR GENWAL RESOURCES, INC.

Denise A. Dragoo



## PETERSEN HYDROLOGIC

7 July 2016

Ms. Denise Dragoo  
Snell & Wilmer, L.L.P.  
15 West South Temple, Suite 1200  
Beneficial Tower  
Salt Lake City, Utah 84101

Denise,

At your request, we have evaluated recent total iron concentrations in the Genwal Resources, Inc. Crandall Canyon Mine discharge water for the six-month period from January 2016 through June 2016. The findings of our evaluation are presented in this letter report. The reader is referred to our previous report entitled *Investigation of Iron Concentrations in the Genwal Resources, Inc. Crandall Canyon Mine Discharge Water*, dated 7 November 2011, and also to our 10 January 2013, 11 July 2013, 16 December 2013, 9 June 2014, 15 January 2015, 9 July 2015, and 7 January 2016 update reports for additional supporting information in this regard.

### ***Results of UPDES Monitoring Activities***

Total and dissolved iron concentrations measured in both the untreated (PRE-002) and treated (UPDES 002) Crandall Canyon Mine discharge waters are presented in Table 1. Plots of total iron concentrations in Crandall Canyon Mine discharge waters through June 2016 are presented in Figure 1. A plot of monthly average total iron concentrations in untreated mine discharge water is presented in Figure 2. A plot of dissolved iron concentrations in untreated Crandall Canyon Mine discharge waters is presented in Figure 3. Sulfate concentrations in the untreated mine discharge water are plotted in Figure 4. Yearly average mine-water discharge rates at the Crandall Canyon Mine

correctness of the geochemical model we presented to the Division of Oil, Gas and Mining in February, 2010.

A plot of the annual average daily total iron production from the Crandall Canyon Mine discharge water is provided in Figure 6. The average daily iron production rate is calculated using the yearly average mine water discharge rate and the yearly average total iron concentration of the mine discharge water. From this information, the average amount of total iron that is produced daily in the mine discharge water was calculated for the past six and a half years. It should be noted that the iron produced from the mine is removed from the water at the treatment facility and it is not discharged in appreciable quantities to Crandall Creek. It is apparent in Figure 6 that the iron production rate has decreased steadily from 2010 through the first half of 2016. The average daily iron production from the mine during the first half of 2016 (3.77 pounds per day) is *5.7 times less* than the amount produced in 2010 (21.6 pounds per day). The total iron production during the first half of 2016 decreased by 28 percent relative to the previous year 2015, which is reflective of the continuing decrease in the total iron coming from the Crandall Canyon Mine.

It is noteworthy that, because of both the decreasing total iron concentrations and the decreasing mine-water discharge rates at the Crandall Canyon Mine, the average iron production during 2013, 2014, 2015, and the first half of 2016 was less than that calculated for a UPDES compliant discharge of 1.24 mg/L at a mine-water discharge rate of 477 gpm (the average discharge rate for year the UPDES permit was issued). What this means is that if the average Crandall Canyon Mine discharge water during this most recent 3.5-year period had been allowed to flow untreated into Crandall Canyon Creek, the total iron loading to the creek would have been less than the amount allowed under the UPDES permit stipulation calculations at the time the UPDES permit was issued (i.e. a UPDES compliant water at 2011 mine water discharge rates).

It is apparent in Figure 1 that the magnitudes of the periodic upward spikes in the total iron concentration data since late 2009 have generally trended downward as the non-spike data has also trended downward (there were no significant upward spikes during 2015 and only one spike during the first six months of 2016). This observation is consistent with a declining supply of available iron in the flooded underground mine environment and a gradual sweeping of the residual iron hydroxide particulates from the underground workings over time (i.e. the flow of water through the mine is gradually cleaning out the system).

#### *Other Chemical Trends*

During the period from January 2016 through June 2016 dissolved iron concentrations in the Crandall Canyon Mine pre-treatment water were mostly low (below the lower laboratory detection limit of 0.03 mg/L – see Table 1; Figure 3). It is noted that there were two spikes in the dissolved iron concentration during the first half of 2016 (0.45 mg/L during April and 0.29 mg/L during June). Such upward spikes in the dissolved iron concentrations in the mine discharge have been measured periodically over the discharge history of the mine (Figure 3). The fact that the dissolved iron value measured during April (the month between these two monitoring events) was below the 0.03 mg/L laboratory detection limit suggests that the dissolved iron spikes measured in April and June were not indicative of a major change in the overall mine geochemical environment. We suspect that these values may be reflective of sampling or laboratory error. Future trends in dissolved iron concentrations in the Crandall Canyon Mine discharge water will continue to be monitored to verify this conclusion.

As shown on Figure 4, sulfate concentrations measured in the pre-treatment mine discharge water during this evaluation period were low. The declines in sulfate concentrations are consistent with decreasing levels of pyrite oxidation in the underground mine environment.

As shown on Figure 7, total dissolved solids (TDS) concentrations of the Crandall Canyon Mine discharge water have declined markedly since the initial onset of gravity discharge from the mine in late 2007/early 2008. TDS concentrations spiked sharply with the onset of gravity discharge from the mine, likely in response to increased rates of chemical reactions with minerals in the mine environment that were brought into contact with mine waters in newly flooded portions of the mine (including iron-producing pyrite mineral oxidation and related cascading reactions). As reactants were consumed and the reaction products were flushed from the mine by the flowing mine waters, TDS concentrations declined markedly (Figure 7). Recent TDS concentrations are now equal to or lower than those observed in the mine discharge waters during operational conditions immediately prior to the mine collapse event of August 2007 and the cessation of mine water pumping in September 2007. The plot of declining TDS concentrations in Figure 7 shows that the chemical quality of the water emerging from the mine has improved in an orderly manner over time (i.e. a well-defined exponential decay curve). This observation provides support to the reactant-limited geochemical model presented previously to the Board, which predicts declines in total iron concentrations.

#### ***Mine Water Discharge Rates***

An updated plot of average yearly mine water discharge rates from the Crandall Canyon Mine is presented as a bar graph in Figure 5. It is apparent from Figure 5 that, after peaking at 1,016 gpm in 2001, the rate of mine water discharge from the Crandall Canyon Mine has been gradually decreasing. The average mine-water discharge rate for the first half of 2016 (268 gpm) was the lowest of the previous 15 years since the mine water discharge rate exceeded 1,000 gpm during 2001. The effects of climatic variability are not apparent in the plot.

***Operations at the Crandall Canyon Mine Iron Treatment Facility***

The Crandall Canyon Mine iron treatment facility operated throughout the first half of 2016. The mine-water treatment has been successful at reducing total iron concentrations to levels below the 1.24 mg/L limit of the mine's UPDES discharge permit (see Table 1 and Figure 1). Total iron concentrations in the UPDES 002 discharge water (post-treatment) averaged 0.11 mg/L during this six-month period.

***Future Total Iron Declines***

Total iron concentrations in the *untreated* Crandall Canyon Mine discharge water were in compliance with the UPDES permit limitations during six of the most recent seven months (Table 1).

The information presented in this update continues to support our conclusions that the observed decreasing trends in total iron concentrations are likely a result of 1) the decreasing rate of production of aqueous dissolved iron from pyrite oxidation reactions in the underground mine environment as chemical reactants are consumed, and 2) the gradual flushing of solid iron hydroxide particulate matter from the mine which is transported away from source areas by the current in actively flushing portions of the mine. It is anticipated that continuing declines in total iron concentrations in the mine discharge will occur in the future by these same mechanisms.

Based on extrapolation of historical long-term trends in the total iron concentrations and the reactant-limited geochemical model of the geochemical environment, it is considered likely that total iron concentrations will remain low in the mine discharge water over the long term.

It is noted that while the total iron concentrations during the previous seven-month period were mostly in compliance with the UPDES limit for total iron, there has historically been some temporal variability (upward and downward fluctuations) in total iron concentrations in the mine discharge water over time (Figure 1; Table 1). It is important

to note that the magnitudes of upward and downward “bounces” in the total iron concentrations have become increasingly small as the overall concentration has trended downward (Figure 1). It is considered likely that there will continue to be some fluctuations and “bounces” in the total iron concentrations in the untreated mine discharge water in future months as the overall concentrations continue to decline. However, as the total iron concentrations continue to decline and the magnitudes of the concentration “bounces” remain small, the total iron concentrations will likely remain consistently below the 1.24 mg/L total iron concentration within a reasonable timeframe (i.e. the upward concentration “bounces” will not result in exceedances of the 1.24 mg/L total iron UPDES standard while the average concentration is below the UPDES limit).

We recommend that monitoring of total iron concentrations in the mine discharge water be continued to evaluate future concentration trends and verify that future concentrations remain low.

### ***Conclusions***

Total iron concentrations in the untreated Crandall Canyon Mine discharge water during the January – June 2016 evaluation period were low. Total iron concentrations measured during six of the past seven months in the Crandall Canyon Mine discharge water have been in compliance with the 1.24 mg/L UPDES permit limits for total iron.

The observed chemical compositions and the documented temporal variability in the geochemistry of the mine discharge water are consistent with the hydrogeochemical - hydrogeologic model that describes the source and fate of the total iron in the Crandall Canyon Mine discharge water that we presented in February of 2010.

As stated in our previous reports and testimony before the Board, it remains my professional opinion that perpetual discharge of mine water containing elevated total iron concentrations at the Crandall Canyon Mine will not occur. Rather, continuing future

declines from current levels are anticipated to occur in the future. This conclusion is supported by the combined evidence of the essential absence of a dissolved iron component (noting the two dissolved iron spikes that were observed during the most recent 6-month period), the continuing decline/stabilization of sulfate and TDS concentrations in the water, the declining total iron production from the mine, and the previously discussed general absence of elevated total iron concentrations in gravity discharges of mine water from other coal mines in the region.

Genwal Resources, Inc. currently has a three-year bond in place for the future operation of the Crandall Canyon Mine treatment facility. In my professional opinion, there is a very high probability that the total iron concentration in the untreated Crandall Canyon Mine discharge water will decline to levels consistently below the 1.24 mg/L UPDES limit within this three-year period. (Note that for the previous seven month period, the base total iron concentrations were already consistently below the 1.24 mg/L UPDES limit, with only the single spike in concentration exceeding the UPDES limit).

To verify this conclusion, Genwal Resources, Inc. will continue to collect and analyze hydrologic data relating to the Crandall Canyon Mine discharge as required.

Please feel free to contact me should you have any questions in this regard.

Sincerely,



Erik C. Petersen, P.G.  
Principal Hydrogeologist  
Utah PG #5373615-2250



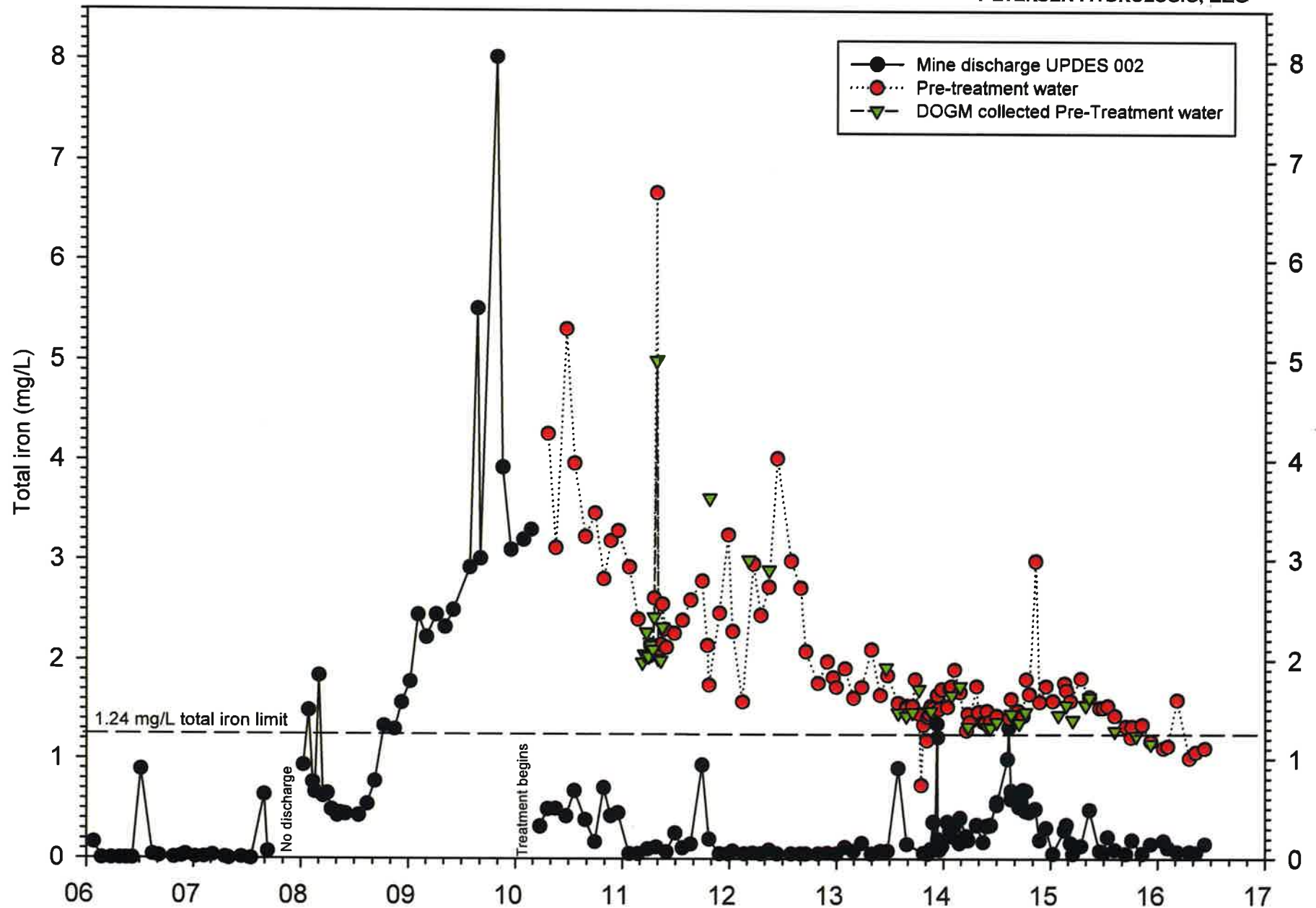


Figure 1 Plots of total iron concentrations in Crandall Canyon Mine discharge water and treated mine discharge water.

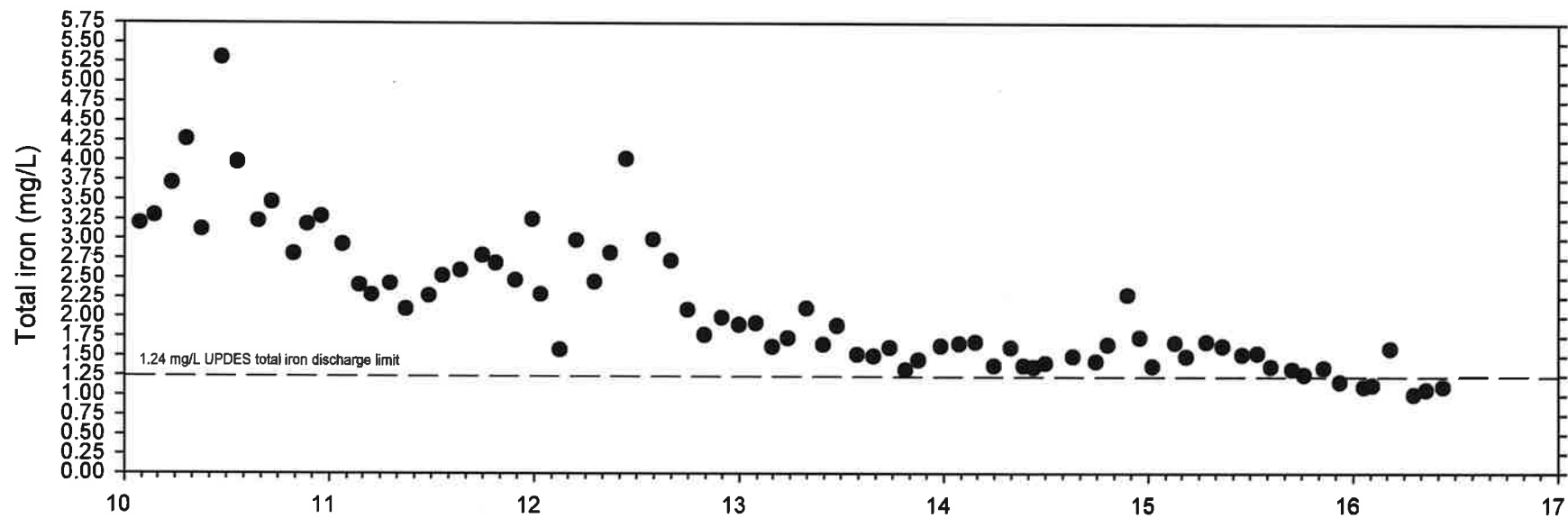
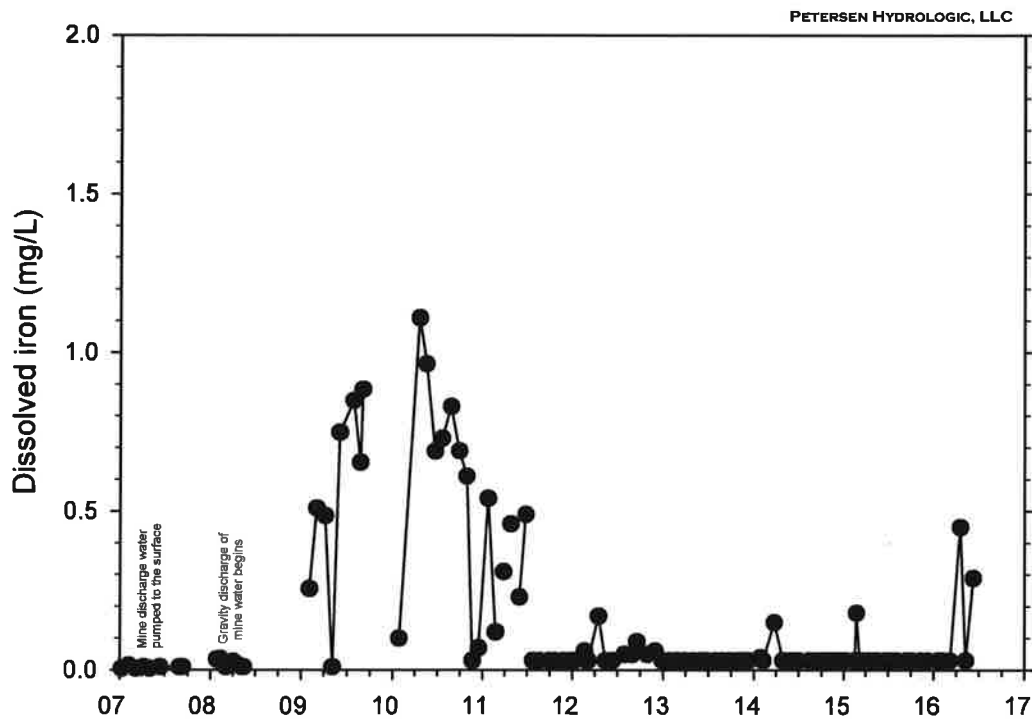


Figure 2 Plot of untreated Crandall Canyon Mine discharge water total iron concentrations (monthly averages) at PRE-002.



Note: The lower laboratory detection limits (plotted on this graph when "less than" results are reported by the analytical laboratory) have varied over time.

Figure 3 Dissolved iron concentrations in Crandall Canyon Mine pre-treatment discharge water, 2007-2016.

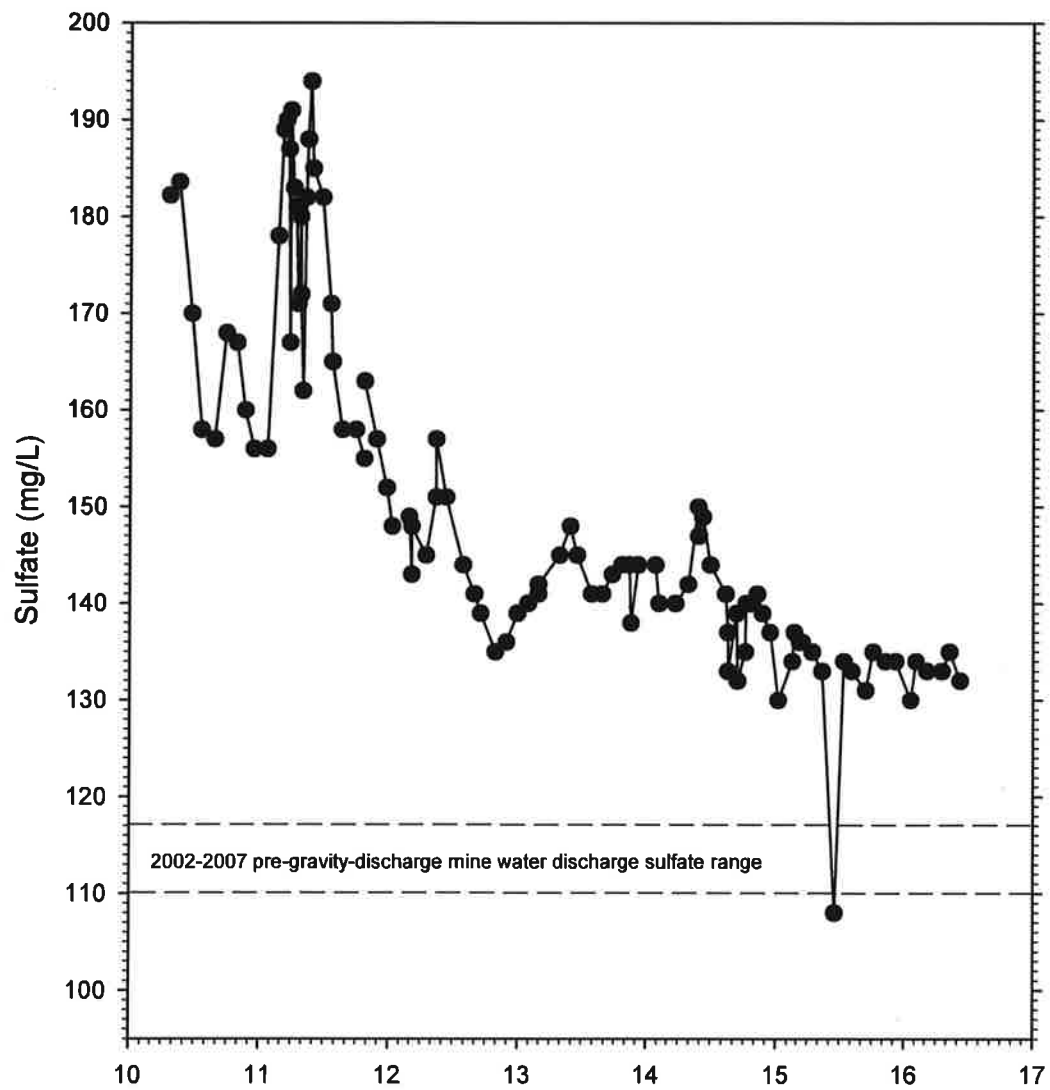
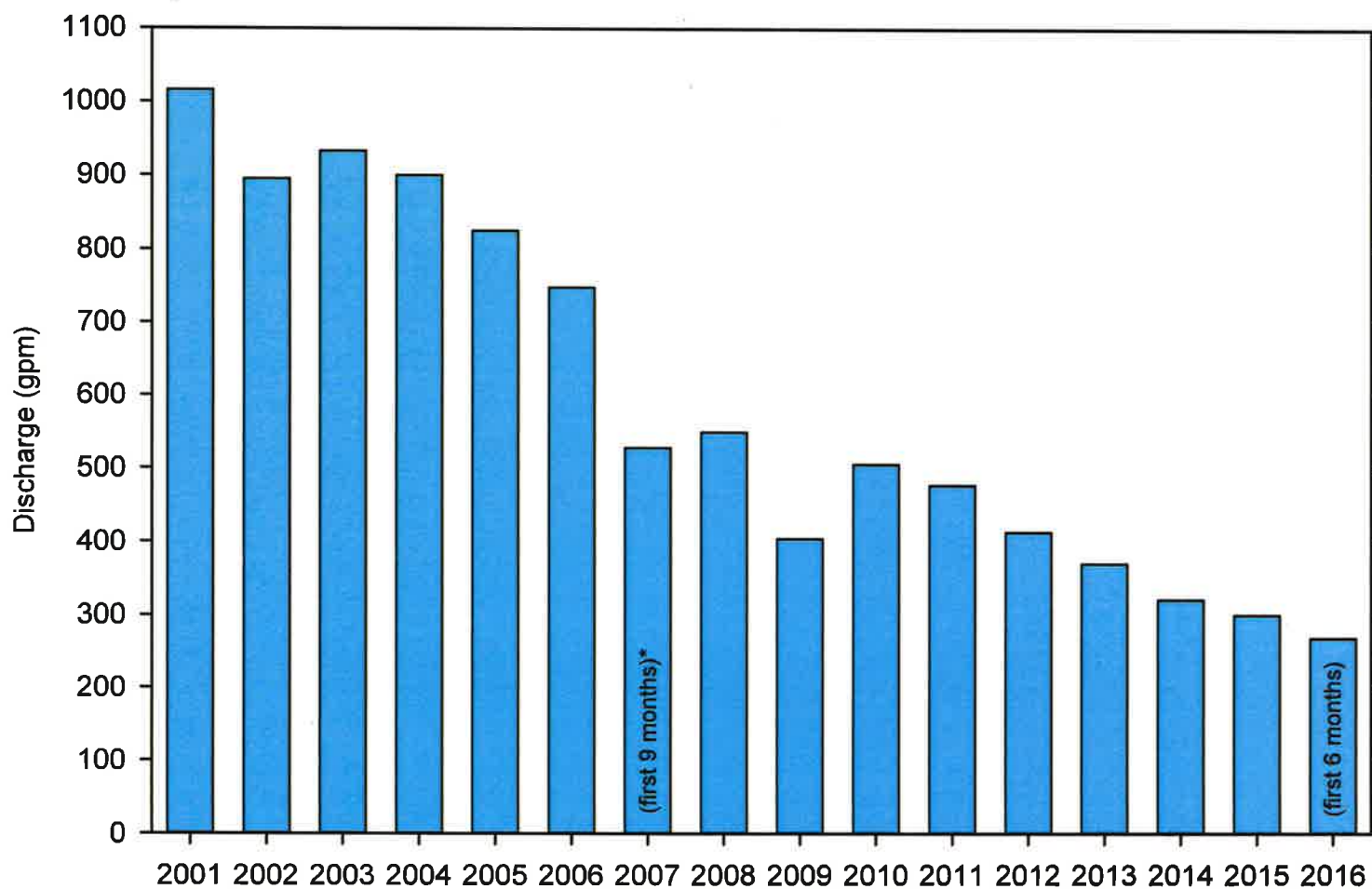


Figure 4 Sulfate concentrations in the Crandall Canyon Mine discharge water (site Pre-002).

## Crandall Canyon Mine Average yearly mine discharge rate



\*The average discharge rate for the first 9 months of 2007 is plotted because during the last 3 months of 2007 the mine pumps had been shut off but gravity discharge of mine water to the surface had not yet occurred.

Figure 5 Average yearly mine water discharge rates for the Crandall Canyon Mine.

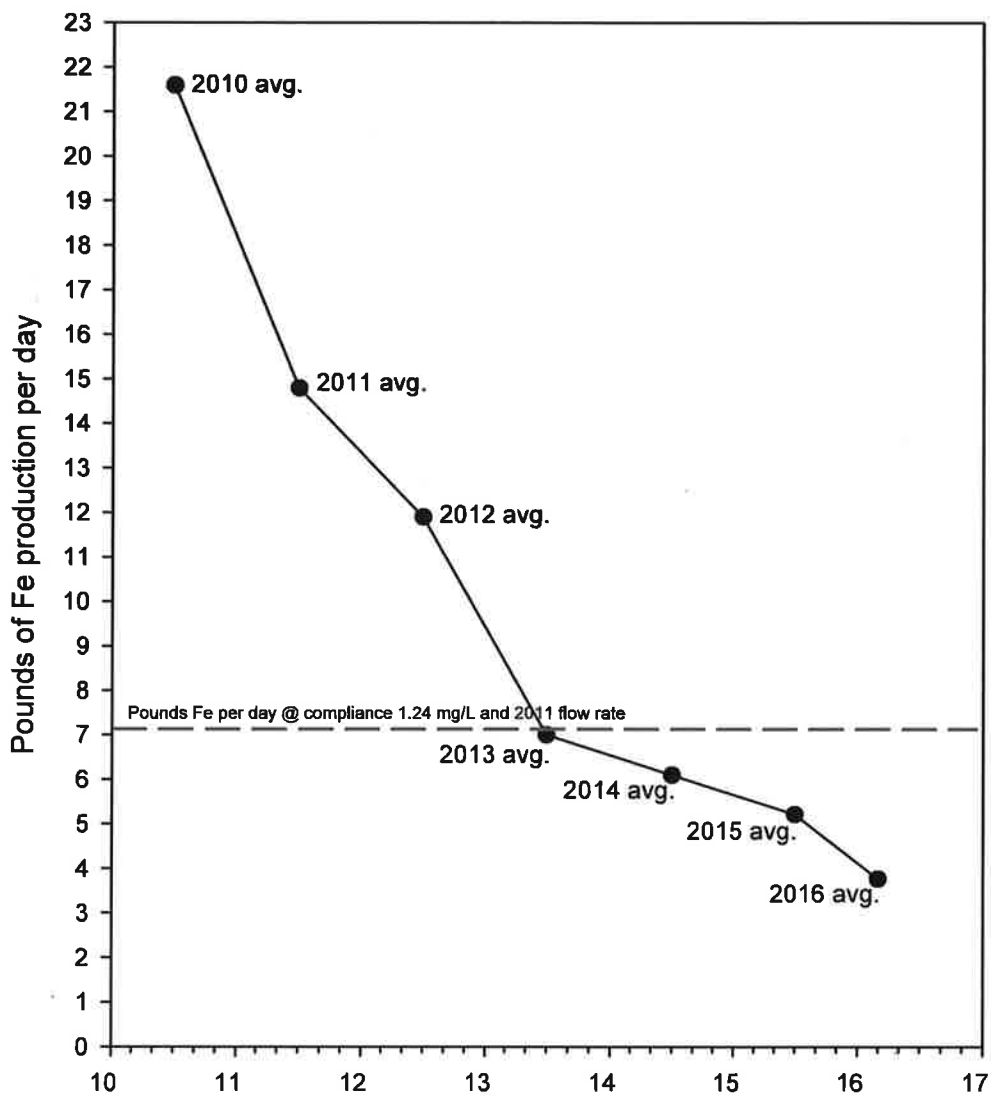


Figure 6 Daily quantity of iron produced by the Crandall Canyon Mine discharge water (calculated from annual average total iron concentration and average annual mine water discharge rate - 2016 average is six-month period January - June).

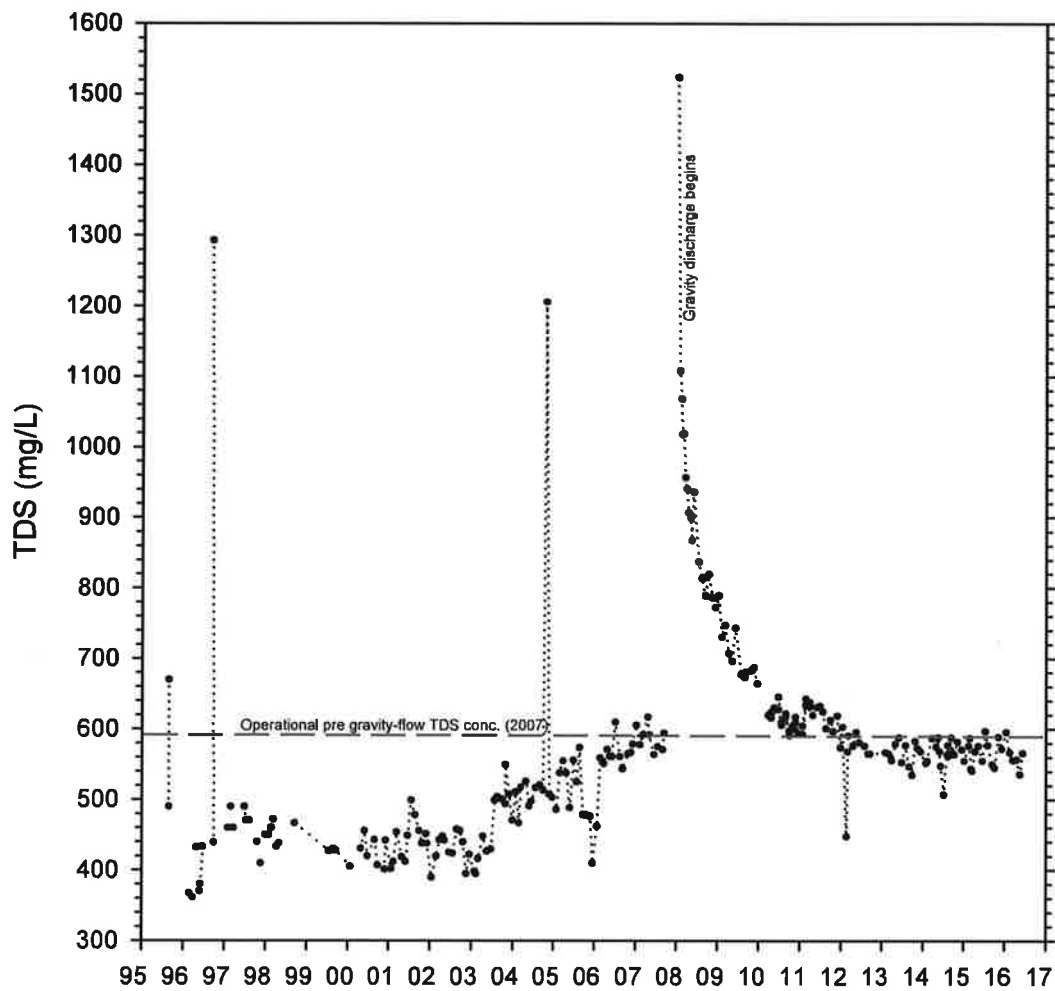


Figure 7 TDS concentrations of Crandall Canyon Mine discharge water.

**Table 1 Total Iron, dissolved iron, and sulfate concentrations in Crandall Canyon Mine discharge water.**

UPDES 002

treated mine water discharged to Crandall Creek

PRE-002

untreated mine discharge water

	Fe (total) mg/L	Fe (dissolved) mg/L		Fe (total) mg/L	Fe (dissolved) mg/L	Sulfate mg/L
1/29/2013	0.12	<0.03	1/29/2013	1.92	<0.03	140
2/28/2013	0.08	<0.03	2/28/2013	1.62	<0.03	141
3/28/2013	0.16	<0.03	3/28/2013	1.73	<0.03	142
4/30/2013	<0.05	<0.03	4/30/2013	2.11	<0.03	145
5/30/2013	0.08	<0.03	5/30/2013	1.65	<0.03	148
6/19/2013*	1.93	---	6/19/2013*	1.93	---	145
6/24/2013	0.08	<0.03	6/24/2013	1.85	<0.03	145
7/30/2013	0.91	<0.03	7/30/2013	1.57	<0.03	141
7/30/2013*	0.880	---	7/30/2013*	1.47	---	148
8/27/2013*	1.090	---	8/27/2013*	1.44	---	153
8/29/2013	0.15	<0.03	8/28/2013	1.54	---	---
9/17/2013	0.07	---	8/29/2013	1.52	<0.03	141
9/17/2013*	0.077	---	9/17/2013	1.54	---	---
9/26/2013	0.16	<0.03	9/17/2013*	1.48	---	135
10/9/2013	0.10	---	9/26/2013	1.81	0.03	143
10/17/2013	<0.05	---	10/9/2013	1.46	---	---
10/24/2013	0.06	<0.03	10/9/2013*	1.71	---	144
11/8/2013	<0.05	---	10/17/2013	0.74	---	---
11/14/2013	0.07	<0.03	10/24/2013	1.35	<0.03	144
11/18/2013	0.37	---	11/4/2013	1.19	---	---
11/19/2013	0.10	---	11/8/2013	1.43	---	---
11/26/2013	0.37	---	11/14/2013	1.46	<0.03	144
12/3/2013	0.10	---	11/16/2013	1.52	---	---
12/10/2013	1.36	0.05	11/19/2013	1.54	---	---
12/10/2013*	1.14	---	11/19/2013*	1.49	---	138
12/11/2013	1.22	---	11/26/2013	1.52	---	---
12/12/2013	0.2	---	12/10/2013	1.65	<0.03	144
12/17/2013	0.09	---	12/10/2013*	1.48	---	---
12/26/2013	0.13	---	12/12/2013	1.65	---	---
1/14/2014	0.37	---	12/17/2013	1.51	---	---
1/22/2014	0.29	---	12/26/2013	1.71	---	---
1/28/2014	0.23	<0.03	1/14/2014	1.53	---	---
1/18/2014*	0.21	---	1/22/2014	1.72	---	---
2/7/2014	0.34	<0.03	1/28/2014	1.74	0.04	144
2/24/2014	0.16	---	1/28/2014*	1.65	---	---
2/26/2014	0.41	---	2/7/2014	1.91	<0.03	140
2/26/2014*	0.40	---	2/26/2014	1.68	---	---
3/20/2014	0.23	---	2/26/2014*	1.74	---	---
3/25/2014	0.19	<0.03	3/20/2014	1.29	---	---
3/25/2014*	0.17	---	3/25/2014	1.46	0.15	140
4/30/2014	0.15	<0.03	3/31/2014	1.38	---	---
4/23/2014	0.34	---	4/23/2014	1.74	---	---
5/16/2014	0.17	---	4/30/2014	1.48	<0.03	142
5/28/2014*	0.33	---	5/16/2014	1.38	---	---
6/10/2014	0.34	<0.03	5/23/2014	1.37	---	---
6/10/2014*	0.34	---	5/28/2014*	1.33	-	150
7/1/2014	0.57	---	5/29/2014	1.49	<0.03	147
7/1/2014*	0.54	<0.03	6/10/2014	1.39	<0.03	149
8/7/2014	1.00	---	6/10/2014*	1.32	---	149
8/11/2014	1.32	<0.03	7/1/2014	1.44	<0.03	144
8/19/2014	0.68	<0.03	7/1/2014*	1.38	---	-
8/19/2014*	0.60	---	8/13/2014	1.42	<0.03	141
9/12/2014	0.61	<0.03	8/19/2014	1.61	<0.03	137
9/15/2014*	0.52	---	8/19/2014*	1.46	---	133
9/29/2014	0.69	---	9/12/2014	1.49	<0.03	139
10/7/2014*	0.48	---	9/15/2014*	1.37	---	132
10/9/2014	0.68	<0.03	9/29/2014	1.44	---	-
10/20/2014	0.47	<0.03	10/7/2014*	1.48	---	135
11/10/2014	0.50	<0.03	10/9/2014	1.81	<0.03	140
11/24/2014	0.19	<0.03	10/20/2014	1.66	<0.03	140
12/16/2014	0.31	<0.03	11/10/2014	2.99	<0.03	141
1/8/2015	<0.05	0.12	11/24/2014	1.58	0.03	139
1/27/2015*	0.28	---	12/16/2014	1.74	<0.03	137
2/17/2015	0.29	<0.03	1/8/2015	1.59	<0.03	130
2/23/2015	0.34	---	1/27/2015*	1.45	---	---
2/23/2015*	0.32	---	2/17/2015	1.77	<0.03	134
3/9/2015	0.16	---	2/23/2015	1.70	0.18	137
3/17/2015	<0.05	<0.03	2/23/2015*	1.55	---	---
3/17/2015*	0.28	---	3/9/2015	1.59	<0.03	136
4/14/2015	0.13	<0.03	3/17/15*	1.40	---	---
4/30/2015*	0.29	---	4/14/2015	1.82	<0.03	135
5/13/2015	0.49	<0.03	4/30/2015*	1.55	---	---
5/13/2015*	0.33	---	5/13/2015	1.63	<0.03	133
6/17/2015	0.08	<0.03	5/13/2015*	1.63	---	---
6/28/2015	0.06	---	6/17/2015	1.52	<0.03	108
7/14/2015	0.22	<0.03	6/29/2015	1.52	---	---
8/7/2015	0.09	<0.03	7/14/2015	1.54	<0.03	134
8/7/2015*	0.12	---	8/7/2015	1.44	<0.03	133
9/14/2015	<0.05	<0.05	8/7/2015*	1.29	---	---
10/5/2015	0.19	<0.03	9/14/2015	1.33	<0.03	131
10/20/2015*	0.05	---	10/1/2015	1.22	---	---
11/19/2015	<0.05	<0.03	10/5/2015	1.33	<0.03	135
12/8/2015	0.15	---	10/20/2014*	1.24	---	---
12/8/2015*	0.16	---	11/9/2015	1.45	<0.03	134
1/20/2016	0.18	<0.03	12/8/2015	1.18	<0.03	134
2/4/2016	0.11	<0.03	12/8/2015*	1.16	---	---
3/7/2016	0.07	<0.03	1/20/2016	1.11	<0.03	130
4/18/2016	0.07	<0.03	2/4/2016	1.13	<0.03	134
5/10/2016	0.06	<0.03	3/7/2016	1.80	<0.03	133
6/9/2016	0.15	<0.03	4/18/2016	1.01	0.45	133
			5/10/2016	1.07	<0.03	135
			6/9/2016	1.11	0.29	132

\* Sample collected by the Utah Division of Oil, Gas and Mining and analyzed by Utah State Department of Health laboratory